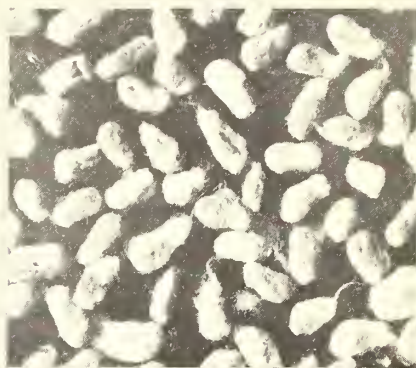
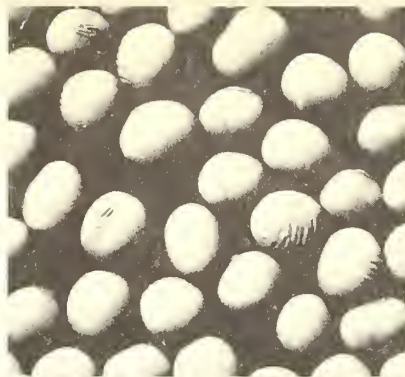


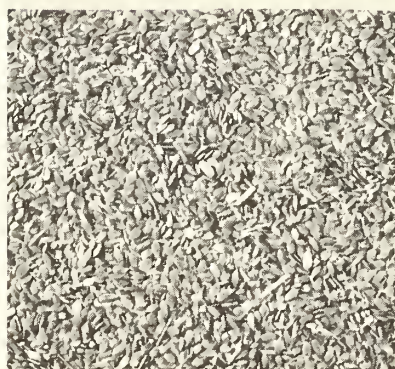
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**Capacity and
Processing Trends
in the**



FATS and OILS INDUSTRY

Marketing Research Report No. 360

Agricultural Marketing Service - Marketing Research Division
UNITED STATES DEPARTMENT OF AGRICULTURE

PREFACE

This report presents background information for the use of the vegetable oilseed industry in adjusting to changes taking place in the production and marketing of vegetable oils. The information on processing and refining capacities and on the volume of vegetable oils used in the manufacture of end products should be helpful to management in improving efficiency by appraising industry requirements and planning better for future operations. Since farmers are suppliers of oilseed commodities and are large consumers of the end products, they can benefit by increased efficiency which helps to stabilize marketing costs and consumer prices. Furthermore, such information is needed by the Government in its various programs, especially defense planning. This project is a part of a broad program of research by the Marketing Research Division to improve the efficiency of marketing agricultural commodities.

Most of the secondary data used in this publication were furnished by the Bureau of the Census, Department of Commerce.

This report brings up to date information pertaining to the processing of soybeans, cottonseed, and flaxseed contained in "Processing the Three Major Oilseeds," Marketing Research Report No. 58, published by the Department in April 1954.

Washington, D. C.

September 1959

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SUMMARY

Increases in the production of soybeans, decreases in the production of cottonseed, and fluctuations in the production of flaxseed have prompted oilseed processors to adjust their operations. Between the 1952-53 and 1957-58 seasons, there were increases of 53.1 and 6.3 percent, respectively, in the quantities of soybeans and flaxseed processed, while the quantity of cottonseed processed decreased 22.4 percent. The total quantity of these oilseeds processed increased about 18 percent. Refiners of vegetable and animal oils and manufacturers using these oils in their products appear to have more than enough capacity to absorb the increase in production.

The major change in the oilseed processing industry since 1952-53 has been a reduction of 20 percent in the number of mills processing soybeans. Eighty-seven of the 139 active soybean mills processed soybeans exclusively in 1957-58, the remaining 52 being primarily cottonseed and flaxseed oil mills processing soybeans after their supply of cottonseed or flaxseed had been exhausted. These mills processed about 354 million bushels of soybeans in 1957-58. Of this quantity, 93 percent was processed by the solvent method of extraction. This was a 2 percent decrease during that season below the 1956-57 percentage, but a 7 percent increase in processing by the solvent extraction method since the 1952-53 season. The remaining 7 percent was processed by the screw-press and hydraulic methods of extraction.

The average crude oil yield per ton of soybeans processed by the various methods was: Solvent extraction, 362 pounds; screw-press and hydraulic, 300 pounds. The U. S. average for all methods was 358 pounds per ton of soybeans.

The 1957-58 processing capacity for the soybean industry was estimated at 453 million bushels. Of this estimated capacity, 78 percent, or about 354 million bushels, was utilized.

For the 1957-58 season, there were in the United States 222 active cottonseed mills which processed 4.2 million tons of cottonseed. Of this amount, 13 percent was processed by the hydraulic method, 58 percent by the screw-press method, and the remaining 29 percent by the solvent method. Cottonseed processed by solvent extraction increased approximately 2 percent for that season over 1956-57, and 8 percent over the 1952-53 season.

During the 1957-58 season, the cottonseed industry utilized approximately 45 percent of its estimated 9.4-million-ton processing capacity. The average crude oil yield per ton of cottonseed processed during that season by the different methods was: Solvent extraction, 376 pounds; screw-press, 327 pounds; and hydraulic, 308 pounds. The United States average oil yield for all methods was 339 pounds.

Eleven mills processed 765,000 tons of flaxseed. Oil yield per ton of flaxseed processed by different methods was: Screw-press, 674 pounds; solvent

extraction, 710 pounds. The United States average for both methods was 699 pounds of crude linseed oil per ton. During the 1957-58 season, the flaxseed industry utilized approximately 63 percent of its estimated 1,218,000-ton crushing capacity.

The vegetable and animal fats and oils refining industry, composed of 126 plants located in 28 States in 1956-57, had an estimated refining capacity of 8.9 billion pounds. Soybean and cottonseed oil accounted for approximately three-fourths of all the oil refined. Eighty percent of the 3.4 billion pounds of soybean oil and approximately 76 percent of the 1.9 billion pounds of crude cottonseed oil was refined. The soybean and cottonseed oil that was not refined was accounted for as losses in refining, crude oil used in the manufacture of industrial products, exports, and ending stocks.

Before refined vegetable and animal oils are used in finished products, they generally undergo secondary processing such as bleaching, hydrogenation, deodorizing, and winterizing. Hydrogenation is one of the more important processes, and during the 1956-57 season about 1.8 billion pounds of vegetable and animal oils were hydrogenated.

The margarine and shortening industries, two of the largest users of vegetable oils, have estimated annual capacities of 1,877 and 2,525 million pounds. Of these two capacities, approximately 77 and 72 percent were utilized during the 1956-57 season. Soybean and cottonseed oils accounted for 93 percent of the total oil used in margarine.

For many years, cottonseed oil was the major oil used in margarine. However, in 1950, soybean oil became the major oil used in this product and during the 1956 season it accounted for 68 percent of the total oil used in margarine.

The major change taking place in the shortening industry is in the relationship of ingredients used in this consumer product. In 1948, soybean and cottonseed oils accounted for 74 percent of the oil used in shortening. Since 1948, the use of animal fats in shortening has been steadily increasing and the use of soybean and cottonseed oils decreasing. By 1957, soybean and cottonseed oils accounted for 59 percent of the total oil used in this product.

Manufacture of edible products other than margarine and shortening in 1956-57 had an oil consumption capacity of approximately 1.5 billion pounds. Winterized and deodorized oils accounted for over half of this amount, and the remainder included other vegetable and animal oils that had been refined or further processed.

The industry using vegetable and animal fats and oils in the production of inedible products had a consumption capacity of approximately 4 billion pounds in 1956-57. Of the total of oils used in the various segments of the inedible products industry, inedible tallow and grease accounted for approximately 43 percent. Linseed was next in importance, accounting for 15 percent, followed by coconut, 11 percent; soybean, 7 percent; and tall oil, 6 percent. The remaining 18 percent comprises other vegetable and animal fats and oils.

CAPACITY AND PROCESSING TRENDS IN THE FATS AND OILS INDUSTRY

By J. Dale Peier and C. B. Gilliland, agricultural economists
Marketing Research Division, Agricultural Marketing Service

INTRODUCTION

Rapid changes in processing of oilseeds after World War II have continued during the period from 1952-53 to 1957-58. The principal changes have been in types of processing equipment and sizes of plants. Since the 1952-53 processing season, there also has been a continued decrease in the number of mills processing the various oilseeds, while the quantity processed per mill has continued to rise. This rise in capacity per mill is due to the expansion of facilities of active mills and the building of larger and more efficient new mills.

Changes in the processes used in removing the oil from oilseeds also are continuing. The cottonseed and flaxseed processing industries have been shifting from the hydraulic-press process to the more efficient screw-press and solvent processes. ^{1/} The soybean industry has been shifting rapidly to the more efficient solvent process, and during the 1957-58 season was well above 90 percent on the solvent basis (fig. 1).

The purpose of this report is to show how processors, refiners, and manufacturers of products using vegetable oils have adjusted their respective industries to handle the expanded output, as a guide in improving efficiency. Any savings effected in the processing and marketing of these products through increased efficiencies can be reflected in the returns to growers and the prices paid by consumers.

VEGETABLE OILSEEDS

From 1952-53 to 1957-58, production of vegetable oilseeds trended steadily upward. Increases in production of soybeans and flaxseed more than offset a decrease in the production of cottonseed. The result has been larger supplies of oilseeds and a greater quantity processed (table 1).

Soybeans

The soybean, a crop of relatively little importance 25 years ago, has swept ahead of its rivals to become the leading oilseed produced in the United States.

^{1/} Solvent extraction includes the prepress-solvent process.

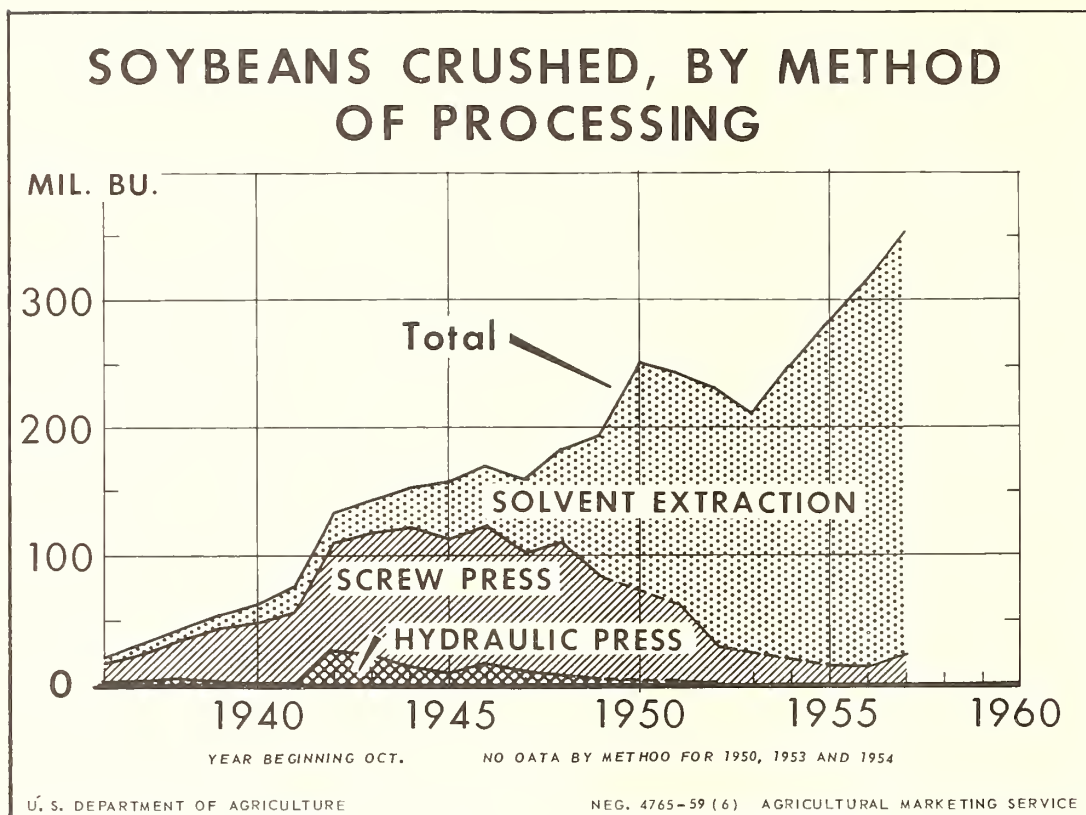


Figure 1

Table 1.--Number of oil mills and quantities of soybeans, cottonseed, and flaxseed processed during 1952-53 and 1957-58 seasons

Oilseed	1952-53		1957-78	
	Mills <u>1/</u>	Quantity processed <u>1/</u>	Mills <u>2/</u>	Quantity processed <u>2/</u>
	<u>Number</u>	<u>Tons</u>	<u>Number</u>	<u>Tons</u>
Soybeans	174	7,016,400	3/139	10,614,148
Cottonseed	303	5,459,000	3/222	4,235,180
Flaxseed	18	719,461	11	765,029

1/ Data from Marketing Activities, June-August 1954.

2/ Compiled from data made available by Bureau of the Census.

3/ Includes mills that process both cottonseed and soybeans.

Soybean meal is used largely for livestock feed, though its use in food and industrial products is increasing. Soybean oil has a multitude of uses, though its principal use is in shortenings, margarine, salad oils, and other edible products. A considerable amount is used industrially as a drying oil, and a small quantity goes into the production of other inedible products. ^{2/}

Another factor that has played an important role in the soybean industry since 1954 has been the effect of Public Law 480. ^{3/} Enactment of this law opened new markets for soybean oil in many foreign countries which had previously been economically unable to buy it. Net exports of soybeans have been increasing. Exports have risen from 0.5 percent of the total supply in 1942-43 to 19.0 percent in 1956-57 (table 2).

Location and type of soybean oil mills

To enable domestic mills to process the continually increasing supply of soybeans, adjustments were made in the techniques of processing and in the size of individual processing plants. Many soybean processors also found it necessary to increase the length of their operating season. Though there is considerable variation in different regions, the average length of season in the United States for mills processing only soybeans is about 11.5 months. The hydraulic-press method was the first used in processing soybeans. This method was rapidly replaced by the more efficient screw-press method of oil extraction, which remained the leading process in this industry until the 1949-50 season. Then the solvent method of extraction gained the leading position.

In 1952-53, the solvent method accounted for approximately 86 percent of the beans processed, and the proportion rose to 95 percent in 1956-57. During the 1957-58 season, solvent extraction accounted for 93 percent of the 354 million bushels of soybeans processed, and the remaining 7 percent of beans were processed by the screw-press and hydraulic methods (fig. 2). This decrease in the percentage of soybeans processed by solvent extraction between 1956-57 and 1957-58 is due largely to the fact that an increased number of screw-press cottonseed oil mills processed soybeans after completing their crush of cottonseed. The shift in methods of extracting oil from vegetable oilseeds has been most evident in the soybean industry, but this transition is taking place, at a somewhat slower rate, in other oilseed processing industries also (table 3).

More than half of the solvent-type mills are located in four of the major soybean-producing States. Of the 354 million bushels processed during the 1957-58 season, these four major soybean States accounted for about 69 percent

^{2/} These include soap, linoleum, oilcloth, resins, etc.

^{3/} Public Law 480 authorizes the President of the United States to negotiate and carry out agreements with friendly nations or organizations of friendly nations to provide for sale of surplus agricultural commodities for foreign currencies.

Table 2.--Supply and disappearance of soybeans, United States, by crop years, 1942-43 through 1957-58

Crop year (Oct.-Sept.)	Supply			Total	Used for seed	Crushed	Disappearance			Feed and residual	Total
	Stocks (beginning of year)	Pro- duction					Net exports				
	bu.	bu.		bu.	Pct.	bu.	Pct.	bu.	Pct.	bu.	Pct.
1942-43	1,000	1,000	1,000	1,000	11.6	1,000	73.7	1,000	0.5	1,000	14.2
1943-44	6,009	187,524	193,533	20,980	10.5	133,453	75.5	904	.5	25,659	13.5
1944-45	12,537	190,133	202,670	19,758	9.5	142,307	77.3	934	2.5	25,518	10.7
1945-46	14,153	192,121	206,274	18,885	8.4	153,402	81.1	5,029	1.4	21,219	9.1
1946-47	7,739	193,167	200,906	16,473	8.5	159,459	84.1	2,812	1.9	17,806	5.5
1947-48	4,356	203,395	207,751	17,137	8.3	170,245	85.3	3,842	10.2	11,134	4.9
1948-49	5,393	186,451	191,844	15,665	6.8	161,397	81.0	2,943	5.6	9,222	2.0
1949-50	2,617	227,217	229,834	15,381	8.1	183,664	83.3	23,004	9.3	4,604	3.0
1950-51	3,181	234,194	237,375	19,021	6.1	195,265	84.6	13,133	6.0	7,049	---
1951-52	2,907	299,279	302,186	18,225	6.9	251,990	86.3	27,826	11.0	298,027	.8
1952-53	4,159	282,477	286,636	19,539	6.8	244,380	80.4	17,045	13.4	283,061	1.8
1953-54	3,575	298,052	301,627	19,840	7.9	234,404	78.1	31,906	18.2	291,490	.6
1954-55	10,137	269,341	272,478	23,400	7.3	231,200	74.9	39,700	17.9	296,100	-.4
1955-56	1,300	341,100	342,400	24,200	6.9	249,000	75.1	60,600	19.0	332,400	4.7
1956-57	9,900	373,500	383,500	26,100	6.0	283,100	70.3	67,500	18.1	377,000	5/7.0
1957-58	3,700	455,900	459,600	27,000	4/	315,939	74.9	85,400		449,600	
	9,900	483,700	493,600	4/		353,800		85,500		472,500	

1/ October 1 stocks include only old-crop soybeans. October is the first month of the crop year.

2/ Imports negligible.

3/ Mostly quantity in feed, but includes waste, loss, and statistical error in estimates.

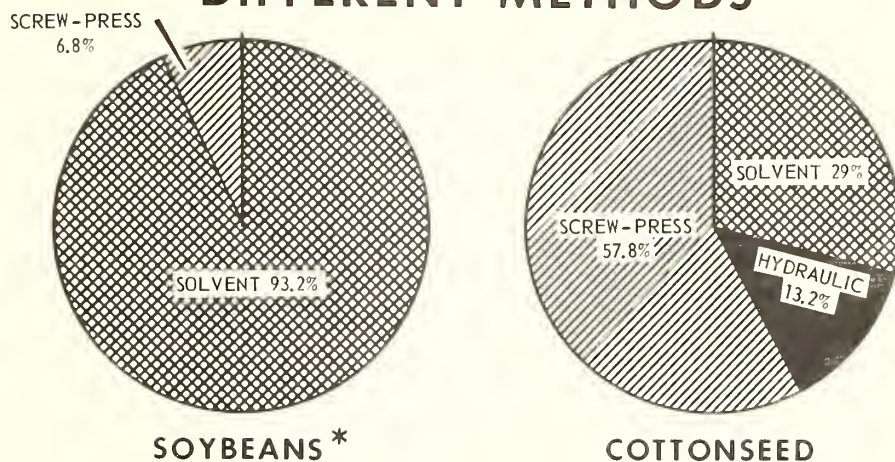
4/ Not available, included in residual.

5/ Includes soybeans used for seed.

Source: Compiled from Processing the Three Major Oilseeds, MRR No. 58, April 1954, and Fats and Oils Situation, FOS 194, January 1959.

1957-58 Season

PROPORTIONS OF SOYBEANS AND COTTONSEED PROCESSED BY DIFFERENT METHODS



* HYDRAULIC INCLUDED WITH SCREW PRESS

U. S. DEPARTMENT OF AGRICULTURE

NEG. 7252-59 (6) AGRICULTURAL MARKETING SERVICE

Figure 2

of the total. Illinois led the States by processing about 34 percent of the beans, followed in order by Iowa, 16 percent; Ohio, 10 percent; and Indiana, 9 percent (table 4). Many of the mills using the screw-press or hydraulic method of extraction are in the Cotton Belt States.

Soybean oil mill operations

Mills ordinarily receive the greatest quantity of soybeans at the peak of harvest, which is usually in October. In the 1957-58 season, the mills received about 26 percent of their soybean supply during this month (table 5).

The quantity of soybeans crushed is generally at its peak during the early part of the processing season, usually from October through February or March. This is the period when newly harvested beans are arriving at the mills. Plant operators try to process a large volume of the beans as they are unloaded at the mill. The meal and oil move rapidly into the marketing channels and therefore mill operators can reduce the cost of handling and storing the portion of beans that are processed upon arrival at the mill. The quantity processed decreases as the soybeans stored at the mill are used up and it is necessary to obtain soybeans that have been stored at elevators and on the farms.

Table 3.--Soybeans, cottonseed, and flaxseed: Quantities processed, oil produced, and oil yield per ton, by type of equipment, United States, 1957-58 ^{1/}

Oilseeds processed, by type of equipment	Crushed	Crude oil produced	Yield per ton
	<u>Tons</u>	<u>1,000 pounds</u>	<u>Pounds</u>
	<u>Percent</u>	<u>Percent</u>	
Soybeans	10,614,148	3,799,511	358
Hydraulic	^{2/}	^{2/}	^{2/}
Screw-press	721,762	216,572	300
Solvent ^{3/}	9,892,386	3,582,939	362
Cottonseed	4,235,180	1,433,949	339
Hydraulic	559,044	172,074	308
Screw-press	2,447,934	800,143	327
Solvent ^{3/}	1,228,202	461,732	376
Flaxseed	765,029	534,590	699
Hydraulic	---	---	---
Screw-press	^{4/}	^{4/}	^{4/}
Solvent ^{3/}	^{4/}	^{4/}	^{4/}

^{1/} Distribution among different processes based on month of largest production for 1957-58 processing year.

^{2/} Hydraulic included with screw press.

^{3/} Solvent extraction includes prepress solvent extraction.

^{4/} Omitted to avoid disclosure of individual plant operations.

Source: Compiled from data collected by Bureau of the Census.

During the early part of the season, when the crush is the largest, the outturns per bushel of cake and meal and crude oil are the lowest. Later in the season, the outturn per bushel increases, since (1) the moisture content of the beans decreases during storage, (2) mill operators are able to adjust equipment for more efficient operation, and (3) the smaller mills with lower outturns per bushel exhaust their supplies of seed and discontinue operations, while larger mills with higher outturns per bushel continue to operate.

The values of the oil and of the meal from a bushel of soybeans have been about equal in the late 1950's. However, a pound of oil is worth several times as much as a pound of meal. During the 1955-56 marketing season, soybean oil

Table 4.--Estimated crushing capacity of soybean oil mills, United States, by States, 1957-58 season

State	Mills	Crushing capacity				Ratio of	
		Total 1/	Utilized	Excess	:utilized :to total		
		1,000	1,000	1,000			
	Number	bushels	bushels	bushels	Percent	Percent	
		Percent	Percent	Percent			
United States ...	<u>2/</u> 139	453,353	353,769	99,584	100.0	78.0	
Illinois	20	135,867	120,343	15,524	34.0	88.6	
Iowa	23	64,918	56,435	8,483	16.0	86.9	
Ohio	9	41,846	34,642	7,204	9.8	82.8	
Indiana	4	36,224	31,298	4,926	8.8	86.4	
Minnesota	9	35,626	26,257	9,369	7.4	73.7	
All others ...	74	138,872	84,794	54,078	24.0	61.1	

1/ Based on a 12-month crushing season and the month of biggest crush for each mill.

2/ Includes 87 mills that crush soybeans exclusively and 52 mills that crush both soybeans and other oilseeds.

Source: Compiled from data collected by Bureau of the Census.

Table 5.--Soybean oil mill operations, by months, 1957-58 season

Month	Soybeans			Cake and meal			Soybean products			Crude oil			Total		
	Received	Crushed	Stocks (end of month)	Produc- tion	Stocks (end of month)	Outturn: per bushel	Produc- tion	Outturn: per bushel	Stocks (end of month)	Produc- tion	Outturn: per bushel	Stocks (end of month)	Outturn: per bushel	Outturn: per bushel	Outturn: per bushel
	Tons	Tons	Tons	Tons	Tons	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
October	1/2,653,638	842,509	2,002,236	652,251	58,636	46.5	306,746	1,000	103,306	1/10.9	57.4	103,306	1/10.9	57.4	
November	1,288,576	876,810	1/2,414,002	683,163	88,112	46.8	313,366	1,000	102,376	10.7	57.5	102,376	10.7	57.5	
December	804,401	852,512	2,365,891	663,254	75,703	46.7	299,940	1,000	105,515	10.6	57.3	105,515	10.6	57.3	
January	667,119	932,722	2,100,288	725,900	78,703	46.7	328,321	1,000	122,751	10.6	57.3	122,751	10.6	57.3	
February	599,734	813,116	1,886,906	628,143	73,367	46.4	288,663	1,000	110,197	10.7	57.1	110,197	10.7	57.1	
March	778,077	925,505	1,739,478	718,450	81,707	46.6	330,112	1,000	116,064	10.7	57.3	116,064	10.7	57.3	
April	757,237	944,311	1,552,404	737,823	74,516	46.9	335,600	1,000	114,377	10.7	57.6	114,377	10.7	57.6	
May	640,221	1/966,248	1,226,377	1/759,192	1/104,661	47.1	1/347,301	1,000	141,927	10.8	57.9	141,927	10.8	57.9	
June	720,606	861,169	1,085,814	669,556	82,345	46.7	310,913	1,000	113,390	10.8	57.5	113,390	10.8	57.5	
July	740,358	898,680	927,492	714,727	61,314	1/47.7	327,856	1,000	119,372	1/10.9	58.6	119,372	1/10.9	58.6	
August	440,796	948,598	419,690	740,537	84,582	46.8	340,868	1,000	99,434	10.8	57.6	99,434	10.8	57.6	
September	748,416	751,968	416,138	591,293	48,066	47.2	269,825	1,000	58,930	10.8	58.0	58,930	10.8	58.0	
Total	10,339,179	10,614,148		8,284,289		46.8	3,799,511			10.7	57.5		10.7	57.5	

1/ Highest level.

Source: Compiled from "Facts for Industry" published by Bureau of the Census.

was worth an average of 12.5 cents per pound or 4.7 times as much per pound as meal. During the following season (1956-57), the oil was worth an average of 12.7 cents per pound or 5.4 times as much per pound as meal. 4/

Since the 1952-53 season, there has been a slight decrease in oil recovery from soybeans. In 1952-53, screw-press yields were 9.1 pounds of oil per bushel and solvent yields were 11.1, compared to 1957-58 screw-press yields of 9.0 and solvent yields of 10.9 pounds. Comparing the crude oil yields per bushel, solvent extraction yields a higher quantity of crude oil per bushel than other processing methods. The United States average for all methods in 1957-58 was 10.7 pounds per bushel (table 6).

Table 6.--Soybeans: Quantity processed, yields of crude oil and cake and meal,
United States, by States, 1957-58 season 1/

State	Processed	Yield of products				Total outturn per bushel
		Crude oil		Cake and meal		
		Produced	Outturn per bushel	Produced	Outturn per bushel	
	<u>Bushels</u>	<u>1,000 pounds</u>	<u>Pounds</u>	<u>Tons</u>	<u>Pounds</u>	<u>Pounds</u>
United States ..	353,769,553	3,799,511	10.74	8,284,289	46.83	57.57
Illinois	120,342,531	1,341,684	11.15	2,766,879	45.98	57.13
Indiana	31,298,270	333,962	10.67	747,668	47.78	58.45
Iowa	56,435,289	595,428	10.55	1,355,955	48.05	58.60
Minnesota	26,257,341	259,000	9.86	608,270	46.33	56.19
Missouri	12,754,291	138,791	10.88	300,140	47.07	57.95
Ohio	34,641,969	369,203	10.66	827,738	47.79	58.45
N. Carolina 2/	1,840,116	16,513	8.97	42,682	46.39	55.36
All other	70,199,746	744,930	10.61	1,634,957	46.58	57.19

1/ October 1, 1957 through September 30, 1958.

2/ Three months estimated.

Compiled from "Facts for Industry" published by Bureau of the Census.

Other changes of importance have been a decrease in number of mills processing soybeans and an increase in the average annual quantity processed per mill. The number of mills has decreased from 174 in 1952-53 to 139 in 1957-58, or approximately 20 percent. But average annual processing per mill has increased from 1,344,000 bushels in 1952-53 to 2,545,100 bushels in 1957-58, or approximately 89 percent. By operating on a large scale, plants are able to take advantage of savings arising from both the processing of soybeans and the marketing of the products.

4/ Pricing Soybeans--An Economic Appraisal of Alternative Methods--
Preliminary Report. H. N. Doughty, U. S. Dept. Agr., AMS-227. 1958.

Crushing capacity of soybean oil mills

During 1957-58 the soybean industry utilized approximately 78 percent of an estimated 453-million-bushel annual processing capacity. ^{5/} The mills utilized the same percentage of their crushing capacity as in 1951-52, since 78 percent of a 310-million-bushel estimated capacity was utilized in that season also. The difference between the estimated crushing capacity and the capacity actually utilized is considered to be the excess crushing capacity. The excess during the 1957-58 season amounted to 99 million bushels. The five major soybean States account for about 46 percent of the excess capacity, and all other States that process soybeans account for the remaining 54 percent. Illinois leads the States with an excess processing capacity equal to 15.6 percent of the total excess for the United States. Other States following in order are: Minnesota, 9.4; Iowa, 8.5; Ohio, 7.2; and Indiana, 5.0. However, Illinois also most fully utilizes its existing estimated processing capacity, using 88.6 percent of it. This State is followed by Iowa, 86.9 percent, and Indiana, 86.4 (table 4).

Cottonseed

The cottonseed industry also has been confronted with numerous problems since 1952-53. Though cottonseed yields per acre have been increasing, the smaller acreages of cotton have greatly reduced the supply of cottonseed (table 7). This reduction in supply has forced some cottonseed processors to rely more heavily on soybeans for sufficient stocks of oilseeds to make their crushing operations profitable.

Changes in the cottonseed processing industry

The shift in types of processing equipment has been slower in the cottonseed industry than in the soybean industry. Cottonseed mills are gradually shifting from the hydraulic method to the more efficient screw-press and solvent methods of extraction. The major reason for the slower shift is the existence of numerous old mills. Many of these older mills have already amortized their plant investments, which gives them a slight advantage in one respect over a new mill. ^{6/}

It appeared for a time that the conversion of hydraulic mills in the cottonseed industry would follow the trend toward solvent extraction, as in the soybean industry. However, the decreasing supply of cottonseed between

^{5/} All capacity figures used in this report are for a 12-month season and based on the month in which the highest level of operation was attained for each individual plant within its respective segment of the fats and oils industry.

^{6/} Comparative Economies of Different Types of Cottonseed Oil Mills and Their Effects on Oil Supplies, Prices, and Returns to Growers. John M. Brewster, U. S. Dept. Agr., MRR No. 54. 1954.

Table 7.---Cottonseed supply and disappearance, United States, crop years 1947-48 through 1957-58

Crop year (Aug.-July)	Stocks			Supply			Disappearance			Residual			Total		
	(beginning of year)	1,000 tons	Production	1,000 tons	Used for seed	1,000 tons	Per- cent	1,000 tons	Per- cent	1,000 tons	Per- cent	1,000 tons	Per- cent	1,000 tons	Per- cent
1947-48	100	4,682	4,782	315	6.7	4,082	87.0	5	0.1	291	6.2	4,693	100		
1948-49	89	5,945	6,034	384	6.5	5,332	90.4	6	.1	180	3.0	5,902	100		
1949-50	132	6,559	6,691	279	4.3	5,712	89.2	11	.2	401	6.3	6,403	100		
1950-51	288	4,105	4,393	419	9.7	3,723	86.0	6	.1	180	4.2	4,328	100		
1951-52	66	6,286	6,352	415	6.7	5,476	88.1	11	.2	313	5.0	6,215	100		
1952-53	137	6,190	6,327	406	6.6	5,563	90.1	13	.2	190	3.1	6,172	100		
1953-54	155	6,748	6,903	346	5.2	6,256	93.7	15	.2	57	.9	6,674	100		
1954-55	229	5,709	5,938	263	4.6	5,249	91.6	21	.4	196	3.4	5,729	100		
1955-56	209	6,043	6,252	266	4.4	5,588	92.0	16	.2	205	3.4	6,075	100		
1956-57	177	5,407	5,584	222	4.1	4,949	91.3	11	.2	238	4.4	5,420	100		
1957-58 2/	164	4,609	4,473	198	4.3	4,235	92.1	12	.3	153	3.3	4,598	100		

1/ Includes cottonseed used by farmers for feed and fertilizer, and loss.
2/ Preliminary.

Source: Fats and Oils Situation, FOS-193, table 13, p. 23, Nov. 1958.

1951-52 and 1957-58 and the high capital investment for solvent plants caused processors to turn to high-speed screw presses.

The use of the more efficient processing equipment and methods places such mills in a better competitive position, since they are able to obtain a higher crude oil yield and to crush larger quantities of cottonseed, and thus lower their unit costs. The small advantage that older mills now hold should disappear as soon as the newer mills have amortized their investments.

Another change in the cottonseed industry has been the shift in cotton growing from the Southeast to the Mississippi Valley and the Southwest. ^{7/} To be near the supply of cottonseed, some of the new mills have been locating in the Mississippi Valley and Southwestern areas. In 1951-52, the Southeast processed 21.5 percent of all cottonseed processed, but this decreased to 16.2 percent in the 1956-57 season. The quantity processed in the Valley and Southwest, combined, increased from 76.1 percent in 1951-52 to 80.1 percent of the total processed in the 1956-57 season. The quantity processed by other cottonseed processing States increased from 2.4 percent in 1951-52 to 3.7 percent in 1956-57, as shown in table 8.

Cottonseed oil mill operations

Cottonseed mills begin operations as soon after harvest as they have a sufficient supply of cottonseed to assure continuous operation. The average of all mills indicates that they continue to operate for about 7.5 months. During the 1957-58 season, about 70 percent of the cottonseed supply was received at the mills during October, November, and December (table 9).

The quantity of cottonseed processed reached its 1957-58 peak during October. However, outturns of products from a ton of cottonseed crushed increase later in the processing season. This is mainly due to the following factors: (1) The moisture content of cottonseed decreases during storage; (2) mill operators are able to adjust equipment for more efficient operation; (3) smaller cottonseed mills with lower outturns per ton exhaust their supply of cottonseed and begin processing soybeans or discontinue operations; and (4) there remains a supply of higher yielding cottonseed, produced in the Southwest, after the lower yielding cottonseed produced in the Southeast has been processed.

An example of the effect of these factors on the yield per ton of cottonseed crushed appears in the moderately increased yield of crude oil per ton in the latter half of the 1957-58 crushing season. Crude oil outturn per ton of cottonseed averaged 336 pounds during the first 6 months of the crushing season, and rose to 342 pounds during the latter 6 months.

^{7/} The Southwest includes California.

Table 8.--Cottonseed production and oil mill operations, United States, by region and State, 1956-57 season 1/

Region and State	Cottonseed										Cottonseed products										Total	
	Produc- tion	Crushed	Crude oil			Cake and meal			Hulls		Produc- tion	Outturn per ton	Produc- tion	Outturn per ton	Produc- tion	Outturn per ton	Produc- tion	Outturn per ton	Produc- tion	Outturn per ton	Total	Outturn per ton
			Produc- tion	Outturn per ton	Produc- tion	Outturn per ton	Produc- tion	Outturn per ton	Produc- tion	Outturn per ton												
	Tons	Tons	1,000 pounds	Pounds	Tons	Pounds	Tons	Pounds	Tons	Pounds	Tons	Pounds	Tons	Pounds	Tons	Pounds	Tons	Pounds	Tons	Pounds	Pounds	Pounds
United States	5,407,000	4,949,437	1,682,368	340	2,385,963	964	1,071,117	433	1,495,709	181	1,918											
Southeast:																						
Alabama	303,000	234,298	74,471	318	116,762	997	55,153	471	67,537	174	1,960											
Georgia	235,000	280,431	88,202	315	141,964	1,012	56,480	403	99,082	210	1,940											
North Carolina	147,000	134,341	42,393	316	61,669	918	26,211	390	52,414	238	1,862											
South Carolina	209,000	155,020	49,487	319	76,161	983	30,462	393	58,343	229	1,924											
Total	894,000	804,090	254,553	317	396,556	986	168,306	419	277,376	206	1,928											
Valley:																						
Arkansas	584,000	447,844	151,473	338	218,217	975	94,080	420	124,590	163	1,896											
Louisiana	238,000	187,632	59,933	319	89,024	949	40,587	433	47,838	157	1,858											
Mississippi	656,000	620,156	203,973	329	315,885	1,019	121,126	391	174,366	169	1,908											
Tennessee	209,000	413,906	147,472	356	201,641	974	87,495	423	115,637	169	1,922											
Total	1,687,000	1,669,538	562,851	337	824,767	988	343,288	411	462,431	165	1,901											
Southwest:																						
Arizona	332,000	286,309	106,152	371	135,233	945	61,313	428	92,340	195	1,939											
California	567,000	528,840	184,091	348	247,531	936	106,477	403	176,116	195	1,882											
Oklahoma	107,000	89,587	28,276	316	45,216	1,009	19,767	441	26,003	175	1,941											
Texas	1,504,000	1,389,834	481,203	346	653,917	941	331,362	477	403,064	175	1,939											
Total	2,510,000	2,294,570	799,722	349	1,081,897	943	518,919	452	697,523	182	1,926											
All other States	316,000	181,239	65,242	360	82,743	913	40,604	448	58,379	191	1,912											

1/ August 1, 1956, through July 31, 1957.
2/ Net weight.

Source: Cotton Production and Distribution, Bulletin 194, Bureau of the Census.

Table 9.--Cottonseed oil mill operations, by months, 1957-58 season

Month	Cottonseed			Cottonseed products									
	Received	Crushed	Stocks (end of month)	Crude oil		Cake and meal		Hulls <u>1/</u>		Linters <u>2/</u>		Total	
				Production	Outturn: per ton:	Production	Outturn: per ton:	Production	Outturn: per ton:	Production	Outturn: per ton:	Outturn	Outturn
	Tons	Tons	Tons	pounds	Pounds	Tons	Pounds	Tons	Pounds	bales	Pounds	Pounds	Pounds
August	238,086	141,951	260,003	48,393	341	71,002	3/1,000	32,441	457	45,398	3/1,990	3/1,990	3/1,990
September	504,250	346,062	418,191	114,715	331	166,582	963	76,115	440	107,384	186	1,920	1,920
October	3/1,139,754	3/645,936	912,009	3/223,092	3/345	3/299,826	928	3/136,097	421	3/199,332	185	1,879	1,879
November	931,617	610,411	1,233,215	203,699	334	280,242	918	131,667	431	177,597	175	1,858	1,858
December	925,266	542,035	3/1,616,446	180,635	333	246,686	910	120,111	443	155,611	172	1,858	1,858
January	272,511	521,545	1,367,412	174,440	334	238,031	913	122,326	469	155,925	179	1,895	1,895
February	81,098	406,501	1,042,009	140,101	3/345	186,389	917	95,020	468	118,546	175	1,905	1,905
March	35,645	327,146	758,322	111,715	341	149,743	915	80,032	489	95,820	176	1,921	1,921
April	11,855	254,651	515,526	87,224	343	117,320	921	60,739	477	69,358	163	1,904	1,904
May	5,001	179,741	340,786	61,675	343	81,357	905	45,564	3/507	48,742	163	1,918	1,918
June	11,583	127,093	225,276	43,206	340	55,749	877	31,124	490	33,846	160	1,867	1,867
July	81,347	132,108	174,515	45,054	341	59,542	901	32,568	493	35,071	159	1,894	1,894
Total	4,238,013	4,235,180		1,433,949	339	1,952,469	922	963,804	455	1,242,630	176	1,892	1,892

1/ Monthly weights may not be accurate since some mills weigh the production of hulls only on an annual basis and estimate the monthly weight. This may result in the weight of the total outturn per ton being either too high or too low during any specific month.

2/ Net weight.
3/ Highest level.

Source: Compiled from "Facts for Industry," published by Bureau of the Census.

The average yield of products per ton of cottonseed crushed during the 1957-58 season was: Crude oil, 339 pounds; cake and meal, 922 pounds, linters, 176 pounds; and hulls, 455 pounds. The remaining 108 pounds is considered to be the processing loss (table 10).

Table 10.--Average yield of products per ton of cottonseed crushed, United States, 1957-58 season

Product	Yield per ton of cottonseed	
	Pounds	Percent
Crude oil	339	17.0
Cake and meal	922	46.1
Linters <u>1/</u>	176	8.8
Hulls	455	22.7
Processing loss <u>2/</u>	108	5.4
Total	2,000	100.0

1/ Net weight.

2/ Difference between total yield and 2,000 pounds considered processing loss. Includes motes, grabbots, and loss of moisture.

Location of cottonseed oil mills

The number of cottonseed processing mills in the United States has continued to decrease, falling from 303 mills in the 1952-53 season to 222 in the 1957-58 season. All areas have been affected by this decrease. The Mississippi Valley had the smallest decrease in number of mills in operation, the number falling from 87 to 73, a decline of about 16 percent. The Southwestern area had a decrease of 25 mills, or about 22 percent, while the number in the Southeast fell from 103 in 1952-53 to 61 in 1957-58, a decrease of about 41 percent.

Though the decline in production of cottonseed is small in comparison to the decrease in the number of processing mills, the remaining mills have more than enough capacity to process the present production of cottonseed. Certain mills expanded their facilities and installed more efficient processing equipment. However, for some time the cottonseed processing industry has not had a sufficient supply of cottonseed to operate at full capacity, even for an 8-month season.

Cottonseed processed, by method of extraction

Of the 222 mills operating during the 1957-58 season, 52 were hydraulic, 137 screw-press, and the remaining 33 were of the solvent-extraction type (table 11).

Table 11.--Number of cottonseed oil mills, by extraction process,
United States, by regions and States, 1957-58 season 1/

Region and State	Mills crushing cottonseed by--							
	Hydraulic press		Screw press		Solvent extraction <u>2/</u>		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
United States	52	100.0	137	100.0	33	100.0	<u>3/</u> 222	100.0
Southeast:								
Alabama	5	9.7	8	5.8	1	3.0	14	6.3
Florida	--	--	--	--	1	3.0	1	.4
Georgia	6	11.5	11	8.0	2	6.2	19	8.6
North Carolina..	6	11.5	5	3.7	1	3.0	12	5.4
South Carolina..	4	7.7	11	8.0	--	--	15	6.8
Total	21	40.4	35	25.5	5	15.2	61	27.5
Valley:								
Arkansas	2	3.8	8	5.8	6	18.2	16	7.2
Louisiana	6	11.5	6	4.4	1	3.0	13	5.9
Mississippi <u>4/</u> ..	6	11.5	12	8.7	10	30.3	28	12.6
Missouri	--	--	3	2.2	--	--	3	1.3
Tennessee	1	2.0	9	6.6	3	9.1	13	5.9
Total	15	28.8	38	27.7	20	60.6	73	32.9
Southwest:								
Arizona	--	--	5	3.7	1	3.0	6	2.7
California	--	--	9	6.6	2	6.2	11	5.0
New Mexico	--	--	3	2.2	--	--	3	1.3
Oklahoma	1	2.0	6	4.4	--	--	7	3.2
Texas <u>5/</u>	15	28.8	40	29.2	5	15.0	60	27.0
Total	16	30.8	63	46.1	8	24.2	87	39.2
Other:								
Illinois	--	--	1	.7	--	--	1	.4

1/ August 1, 1957, through July 31, 1958. Mills dormant during the season not included. Mills using more than one type of extraction process classified according to their major type of process.

2/ Includes prepress-solvent extraction.

3/ 45 mills crushed both cottonseed and soybeans.

4/ Does not include 2 mills that delint and dehull, then ship to another mill for crushing.

5/ Does not include 5 mills that delint and dehull, then ship to another mill for crushing.

In the 1957-58 season, about 4.2 million tons of cottonseed were processed. Of this, 13 percent was processed by the hydraulic method, 58 percent by the screw-press method, and the remaining 29 percent by the solvent-extraction method (table 3). Cottonseed processed by the solvent method has increased about 8 percent since the 1952-53 season, and that processed by the high-speed screw-press method has increased about 25 percent.

The outturn of crude cottonseed oil per ton of cottonseed processed showed a great deal of variation among areas during the 1956-57 crop year. The Southeastern area had a crude oil outturn per ton of 317 pounds, compared to 337 for the Valley and 349 for the Southwest (table 7). This difference is accounted for largely by the fact that 28 of the 33 solvent-extraction mills, which recover a higher percentage of crude oil, are located in the Valley and Southwest. Those two areas also produce higher oil-yielding cottonseed than that grown in the Southeast.

Since the 1952-53 season, the oil yield per ton of cottonseed crushed has increased from 328 to 339 pounds per ton. This increase is due in part to the solvent method of extraction, which has increased production from 368 pounds per ton in 1952-53 to 376 pounds in 1957-58. Oil yield per ton for the hydraulic method has decreased from 310 to 308 pounds, while the yield for the screw-press method has remained approximately the same for both periods, or about 327 pounds. Because of the great variation in oil content of the cottonseed processed, the yield for the screw-press method does not reflect the gain in extraction efficiency resulting from increased use of high-speed screw presses. From the 4.2 million tons of cottonseed processed, 1.4 billion pounds of crude cottonseed oil was produced, or an average of 339 pounds of crude oil per ton of seed.

Cottonseed oil mill processing capacity

The cottonseed processing industry, during the 1957-58 season, utilized approximately 45.1 percent of its estimated annual crushing capacity of 9.4 million tons.

Excess crushing capacity during the 1957-58 season was about 5 million tons. The States most fully utilizing their estimated crushing capacity were those classified as "all other," ^{8/} which utilized approximately 75 percent of their estimated capacity of 191,000 tons. The States utilizing the least of their capacity were Arkansas and Louisiana. These States utilized about 36 percent of their estimated 1.4-million-ton crushing capacity (table 12).

Flaxseed

Since the 1952-53 season, the biggest change that has taken place in the flaxseed industry has been the decline in number of mills in operation from 18

^{8/} This group includes Florida, Missouri, New Mexico, and Illinois. This group could not be shown by States, because State figures would disclose individual mill operations.

Table 12.--Cottonseed: Estimated crushing capacity, 1957-58 season

Area and State	Mills	Crushing capacity						Ratio of utilized :to total
		Total 1/	Utilized 2/	Excess				
	Number	Tons	Percent	Tons	Percent	Tons	Percent	Percent
United States ..	222	9,380,868	100.0	4,235,180	100.0	5,145,688	100.0	45.1
Ala., Ga.	33	954,168	10.2	415,048	9.8	539,120	10.5	43.5
N. C., S. C.	27	561,636	6.0	237,170	5.6	324,466	6.3	42.2
Tenn.	13	937,584	10.0	351,520	8.3	586,064	11.4	37.5
Miss.	28	1,066,968	11.4	520,927	12.3	546,041	10.6	48.8
Ark., La.	29	1,440,972	15.3	516,692	12.2	924,280	18.0	35.9
Tex., Okla.	67	2,748,996	29.3	1,279,024	30.2	1,469,972	28.5	46.5
Calif., Ariz.	17	1,479,576	15.8	770,803	18.2	708,773	13.8	52.1
All other 3/ ..	8	190,968	2.0	143,996	3.4	46,972	.9	75.4

1/ Based on a 12-month crushing season and the month of biggest crush for each mill.

2/ Quantity crushed by State or area, partly estimated.

3/ Includes Missouri, New Mexico, Illinois, and Florida.

Source: Compiled from data collected by Bureau of the Census.

to 11 in the 1957-58 season. The five mills located in Minnesota accounted for approximately three-fourths of the flaxseed processed in 1957-58.

About the same quantity of flaxseed was being processed in the late 1950's as earlier. The decrease in mill numbers has been counterbalanced by an increase in the average volume per mill through improved equipment and better utilization of facilities. The average quantity processed per mill has risen from 1.4 million bushels in the 1952-53 season to 2.5 million bushels in 1957-58.

Flaxseed exports during 1952-53 to 1957-58 fluctuated more than the exports of soybeans and cottonseed. The percentage of flaxseed exported during that period ranged from less than 1 percent to approximately 25 percent of the crop (table 13).

Linseed oil mill operations

The largest quantity of flaxseed is usually received at the mills during September, October, and November. During the 1957-58 season, the largest quantity was received during October, although the largest quantity was processed during August. The highest outturn per bushel was not reached until processing was at a much lower point. Though the monthly variation of yields was quite small, the greatest outturn for cake and meal, 38.0 pounds per bushel, was achieved during April, whereas the greatest outturn per bushel of crude linseed oil, 20.7 pounds per bushel, was attained during March. For the 1957-58 season, the average outturn of cake and meal was 37.0 pounds per bushel and outturn of crude linseed oil was 19.6 pounds (table 14).

During the 1957-58 season, flaxseed was processed only by the screw-press and solvent methods of extraction. The oil yield per ton of flaxseed processed during the 1957-58 season was estimated at 674 pounds per ton for the screw-press method, and 710 pounds for the solvent method. A total of 535 million pounds of crude linseed oil was extracted from the 765,000 tons of flaxseed processed, or an average for both processes of 699 pounds of crude linseed oil per ton (table 3).

During the 1957-58 season, the flaxseed industry utilized approximately 63 percent of its estimated crushing capacity of 1,218,000 tons a year.

REFINING AND OTHER PROCESSING OF VEGETABLE AND ANIMAL FATS AND OILS

Refining

Refining, as used in this report, refers to the removal of certain minor constituents from crude fats and oils, with as high a yield as possible of purified glycerides. The minor constituents removed are foreign matter, moisture, nonfatty materials which are loosely termed "gums" or phosphatides, color bodies or pigments, and, in most cases, free fatty acids.

Table 13.--Flaxseed supply and disappearance, United States, crop years 1947-48 through 1957-58

Crop year (July-June) of year)	Supply			Disappearance					
	Stocks (beginning Imports)	Pro- duction	Used for seed	Crushed	Exports	Other	Total	L/	
	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	
1947-48	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
1948-49	721	40,618	3,204	29,871	22	2,707	2,707	35,804	
1949-50	618	54,803	3,505	36,024	4,674	-920	-920	43,283	
1950-51	2	42,976	2,769	48,453	1,991	2,160	2,160	45,373	
1951-52	---	40,236	2,743	43,037	2,874	-3,736	-3,736	44,918	
1952-53	---	34,696	2,326	30,128	4,169	-1,158	-1,158	35,465	
1953-54	---	30,174	2,733	25,407	199	3,400	3,400	31,739	
1954-55	---	36,813	3,900	27,800	2,400	-700	-700	33,400	
1955-56	---	41,300	3,500	32,300	8,200	300	300	44,300	
1956-57	---	41,300	3,900	34,900	10,400	-1,000	-1,000	48,200	
1957-58	---	48,700	3,900	26,098	2,500	800	800	33,300	
	---	25,800	3,000	27,300	9,000	-2,900	-2,900	36,400	

L/ Domestic disappearance plus linseed oil exports.
2/ Preliminary.

Source: Fats and Oils Situation, FOS 187, November 1957, and Fats and Oils Situation, FOS 193, November 1958.

Table 14.--Linseed oil mill operations, United States, by months, 1957-58 season

Month	Flaxseed										Flaxseed products										Total	
	Received		Crushed		Stocks (end of month)		Production		Stocks (end of month)		Cake and meal		Outturn		Production		Stocks (end of month)		Outturn		Total	
	Tons		Tons		Tons		Tons		Tons		Tons		per bushel		per bushel		per bushel		per bushel		per bushel	
July	97,438		85,538		77,742		54,160		36,459		1,000		35.5		61,488		34,431		20.1		55.6	
August	89,915		2/94,448		73,209		2/60,927		49,192		2/68,387		36.1		2/68,387		42,944		2/20.3		56.4	
September	2/114,057		83,468		103,798		55,169		63,686		58,787		37.0		58,787		46,864		19.7		56.7	
October	78,866		76,434		106,230		50,887		70,261		52,829		37.3		52,829		38,538		19.4		56.7	
November	90,739		66,439		130,530		44,796		2/70,383		45,699		37.8		45,699		45,697		19.3		57.1	
December	50,996		57,944		123,582		38,282		63,582		39,771		37.0		39,771		59,746		19.2		56.2	
January	60,466		51,925		2/132,123		34,317		50,653		35,847		37.0		35,847		61,883		19.3		56.3	
February	38,589		54,375		116,337		36,440		43,265		37,788		37.5		37,788		70,586		19.5		57.0	
March	28,115		64,733		79,719		42,732		43,834		44,166		37.0		44,166		2/76,703		19.1		56.1	
April	26,991		47,157		59,553		32,026		34,591		32,888		2/38.0		32,888		70,119		19.5		2/57.5	
May	30,854		44,380		46,027		29,806		29,407		30,597		37.6		30,597		68,481		19.3		56.9	
June	35,469		38,188		43,308		25,798		23,920		26,343		37.8		26,343		54,265		19.3		57.1	
Total	742,495		765,029				505,340				534,590		37.0						19.6		56.6	

1/ The total outturn per bushel may exceed 56 pounds since some mills add flaxseed screenings to the meal to lower the protein content.
2/ Highest level.

Source: Compiled from "Facts for Industry" published by Bureau of the Census.

The industry refining vegetable and animal fats and oils has an estimated annual refining capacity of 8.9 billion pounds. It is largely dependent upon production by oilseed processors, since vegetable oils constitute the major portion of edible oils produced in the United States. In the 1956-57 season, the refining industry comprised 126 plants located in 28 States. California had the largest concentration of plants, totaling 21, followed by Illinois with 16 and Texas with 14. The average length of plant operation during the 1956-57 season was about 11.5 months; however, 103 of the 126 plants operated for the full 12 months.

Refining is the most important process applied to vegetable oils before they are converted into finished products. If the oil is not properly refined, subsequent steps, including bleaching, hydrogenating, winterizing, deodorizing, and various other processes, do not proceed smoothly and the final product is not up to the desired quality standards.

The two principal methods used in refining vegetable and animal fats and oils are the kettle or batch method and the continuous refining method.

The kettle method of refining, though largely replaced by continuous refining, is still used successfully in the refining of coconut oil and cottonseed oil, as well as the re-refining of cottonseed oil to improve this oil's color.

In recent years, the increased use of solvents for extracting crude oil from oilseeds has created a new problem for the oilseed processor. Since solvent extraction is exceptionally efficient in extracting the crude oil, the resulting meal is dry and dusty. Consequently much meal is lower in quality from the standpoint of residual oil content; however, the meal may be of higher quality as to protein content. This situation leaves solvent extraction plants with two alternatives: (1) Leave oil in the cake, and thus lose much of the advantage of solvent extraction, or (2) put some less expensive oily product into the meal. Efforts to solve this problem led to the introduction of degumming the crude oil and "miscella" refining. Basically, degumming is the removal of only the phosphatide gums. However, in miscella refining, the miscella (a mixture of crude oil and solvent) from the extraction plant is mixed with a caustic soda solution to neutralize the free fatty acids, coagulate the phosphatides, and remove most of the coloring matter. 9/

Miscella refining and degumming must be carried out at the crude oil mill if its full potentialities are to be realized. Cottonseed oil mills are the only oilseed processing mills employing miscella refining, while most of the degumming is done at soybean mills. The two main advantages of using miscella refining and degumming are: (1) The mill is in a position to increase its gross revenue, since it is now marketing a refined or semirefined oil instead of a crude oil, and (2) even more important, the phosphatidic gums and soapstock can be added back to the meal, increasing both its quality and its value.

9/ Sullivan, Frank C. Continuous Degumming and Refining in Miscella. Oil Mill Gazetteer (Vol. 62, No. 2) 1957.

Soybeans and cottonseed account for approximately three-fourths of all the animal and vegetable oils refined. During the 1956-57 marketing season, 80 percent of the 3.4 billion pounds of soybean oil and approximately 76 percent of the 1.9 billion pounds of crude cottonseed oil was refined (table 13). The difference between production of crude oil and the quantity refined was accounted for as losses in refining, crude oil used in the manufacture of industrial products, exports, and ending stocks (table 15). Other important crude oils, though constituting a smaller portion of the oil refined, are peanut, coconut, linseed, inedible tallow and grease, and glycerin (table 16). Other crude fats and oils also are refined, but the quantities of these are so small that they are handled only in a few refining plants. 10/

Table 15.--Factory production of crude, refined, and hydrogenated cottonseed and soybean oils, 1956-57 season 1/

Vegetable oil	Quantity of crude oil	Quantity of refined oil	Ratio of refined to crude oil	Quantity of hydrogenated oil	Ratio of hydrogenated to refined oil
	1,000 pounds	1,000 pounds	Percent	1,000 pounds	Percent
Cottonseed ..	1,682,368	1,279,327	76.0	442,065	34.6
Soybean	3,431,329	2,732,111	79.6	1,201,559	44.0
Total <u>2/</u> ..	5,113,697	4,011,438	78.4	1,643,624	41.0

1/ October 1, 1956, through September 30, 1957.

2/ Factory production of minor oilseeds not included to avoid disclosure of individual plant operations.

Source: Compiled from "Facts for Industry," published by Bureau of the Census.

Other Processing

Before refined vegetable or animal oils are used in finished products, they generally undergo other secondary processing such as bleaching, hydrogenating, deodorizing, and winterizing, the most important of these processes being hydrogenation. Hydrogenation is employed on a vast scale in both the soap and edible fat industries, for converting liquid oils to hard or plastic fats, for converting soft fats to firmer products, and for improving the resistance of fats and oils to deterioration through oxidation or flavor reversion. A simple definition might be: A method used to raise the melting point of fats so that they are solid instead of liquid at room temperatures.

10/ Other minor crude fats and oils that are refined include those described as maize (sorghums), corn, palm, apricot, walnut, mustard, castor, tung, lard, tallow, fish, and tall oil, the last a byproduct derived from the waste liquors of the pinewood pulp mills.

Table 16.--Number of refineries in operation and quantity of vegetable and animal oils processed during most active month, 1956-57 season, by area and State ^{1/}

Area and State	Refineries	Refined and quantity further processed							
		Oils refined ^{2/}							
		Cotton-seed	Peanut	Soybean	Coconut	Linseed	Tallow and grease	Other (inedible)	All oils ^{3/}
	No.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.
United States	126	172,062	6,941	364,178	43,614	35,152	19,316	68,402	28,297
Mass., N.Y., N.J.	14	1,740	5/	73,302	10,943	5/	5/	2,254	5,217
Pa., Ohio, Md., Va., Ky.	16	5/	2,581	55,992	3,665	5/	5/	4,726	5,983
N.C., S.C., Ala., Fla., Miss., Ga.	17	33,448	1,776	7,455	---	---	---	21,862	---
Tenn.	6	35,092	482	34,429	5/	---	---	5/	---
Wis., Mich., Ind., Mo. ...	9	5/	5/	5/	5/	---	3,198	7,206	2,383
Ill.	16	4,104	484	111,786	1,468	5/	5,593	16,779	5/
Okla., La., Tex.	17	52,996	5/	39,638	5/	5/	5/	5/	10,844
Kans., Neb., Iowa, Minn.	10	---	---	5/	5/	26,633	5/	7,238	5/
Calif.	21	38,708	5/	20,791	21,479	5/	4,338	3,687	1,154

Area and State	Processing other than refining ^{4/}						Total		Estimated capacity	
	Fat splitting	Hydro-genating	Winterizing	Deodorizing	Other		Refined	Other	Refined	Other
	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.		1,000 lb.	1,000 lb.	Bil. lb.	Bil. lb.
United States	13,723	184,215	79,274	98,662	23,999		737,962	399,873	8.86	4.80
Mass., N.Y., N.J.	5/	22,413	5/	39,245	5/		99,498	69,874	1.19	.84
Pa., Ohio, Md., Va., Ky.	5/	5/	4,540	10,656	1,563		79,941	41,353	.96	.50
N.C., S.C., Ala., Fla., Miss., Ga.	5/	5/	12,299	5/	5/		64,541	24,552	.77	.29
Tenn.	5/	42,275	10,698	5/	---		70,990	58,055	.85	.70
Wis., Mich., Ind., Mo. ...	5/	16,264	5/	5/	4,887		34,424	26,823	.48	.32
Ill.	3,357	25,411	7,041	31,395	5,090		142,901	72,294	1.72	.87
Okla., La., Tex.	---	27,885	18,074	5/	5/		111,369	51,616	1.34	.62
Kans., Neb., Iowa, Minn.	5/	---	---	---	5/		42,950	9,112	.52	.11
Calif.	5/	15,113	18,144	8,401	5/		91,348	46,194	1.10	.55

^{1/} October 1, 1956, through September 30, 1957. ^{2/} Total refined oil, but large portion undergoes further processing. ^{3/} Includes maize (sorghum), corn, palm, apricot, walnut, mustard, castor, tung, lard, tallow, fish, and tall oil. ^{4/} Includes important processes in treating oils for use in manufacturing consumer products. ^{5/} Not shown to avoid disclosure of individual processor's operations.

Compiled from data collected by Bureau of the Census.

Of the 1.8 billion pounds of vegetable and animal fats and oils hydrogenated in 1956-57, vegetable oils accounted for 1.7 billion pounds, or about 96 percent, while the remaining 4 percent consisted of animal fats and oils. Soybean and cottonseed oils accounted for about 91 percent, or 1.6 billion pounds, of the 1.7 billion pounds of vegetable oils hydrogenated (table 17).

Table 17.--Factory production of hydrogenated vegetable and animal fats and oils, 1956-57 season 1/

Hydrogenated oils	Quantity of oil hydrogenated	Percentage of total
	<u>1,000 pounds</u>	<u>Percent</u>
Vegetable:		
Cottonseed	442,065	24.4
Soybean	1,201,559	66.3
Inedible	<u>2/7,425</u>	.4
Other	82,292	4.5
Total	1,733,341	95.6
Animal:		
Edible	39,522	2.2
Inedible	40,324	2.2
Total	<u>79,846</u>	4.4
Total oils hydrogenated	1,813,187	100.0

1/ October 1, 1956, through September 30, 1957.

2/ Partly estimated (8 of the 12 months estimated).

Source: Compiled from "Facts for Industry," published by Bureau of the Census.

Most of the hydrogenated soybean and cottonseed oils was used in the production of edible products. Ninety-one percent of the hydrogenated soybean oil and 86 percent of the hydrogenated cottonseed oil were used in margarine and shortening. A small quantity of hydrogenated soybean and cottonseed oils was used also in the production of other edible products (table 18).

The combined processing capacity of these processes (bleaching, hydrogenating, etc.), during the 1956-57 season, was estimated at 4.8 billion pounds.

Table 18.--Quantity of hydrogenated oils used in production of margarine, shortening, and other edible products, and ratio of hydrogenated to total oils used, 1956-57 season ^{1/}

Hydrogenated oils	Margarine		Shortening		Other edible oils	
	1,000 pounds	Percent ^{2/}	1,000 pounds	Percent ^{2/}	1,000 pounds	Percent ^{2/}
Cottonseed	232,890	20.1	147,592	8.1	^{3/}	^{4/}
Soybean	755,065	65.0	338,794	18.5	16,394	^{4/}
Other vegetable ..	^{3/}	^{3/}	20,118	1.1	^{5/} 17,319	^{4/}
Animal	^{3/}	^{3/}	12,598	.7	^{5/} 3,003	^{4/}
Total	^{3/}	^{3/}	519,102	28.4	^{3/}	^{4/}

^{1/} October 1, 1956, through September 30, 1957.

^{2/} Based on the assumption that 80 percent of the weight of margarine and 100 percent of the weight of shortening are animal and vegetable oils. During the 1956-57 season, 1,451.3 million pounds of margarine and 1,826.5 million pounds of shortening were produced.

^{3/} Not shown to avoid disclosures of individual plant operations.

^{4/} Insufficient data to show these percentages.

^{5/} Partly estimated (1 of the 12 months estimated).

Source: Compiled from "Facts for Industry," published by Bureau of the Census.

VEGETABLE AND ANIMAL FATS AND OILS USED IN THE PRODUCTION OF EDIBLE PRODUCTS

Manufacturers of margarine and shortening, two major users of vegetable oils, are largely dependent on the production of refined and hydrogenated vegetable oils. In the 1956-57 season, these industries comprised 101 plants located in 31 States (table 19). Texas had the largest concentration of plants, totaling 13, followed in order by Illinois, 12; California, 11; Georgia, 9; and New Jersey, 8. Of the remaining 26 States, 15 had only 1 plant each. Many of these plants produced both margarine and shortening, while some produced only one of those products.

Margarine

Margarine, of minor importance prior to World War II, has rapidly become a major product in the United States. Between 1940 and 1957, the output of this product has increased 350 percent while production of butter has decreased 30

Table 19.--Number of plants in operation and quantity of vegetable and animal oils used in production of shortening and margarine, during most active month, 1956-57 season, by area and State ^{1/}

SHORTENING

Area and State	Mills	Production	Oils used								Lard	Tallow	Glycer- ides
			Cottonseed		Soybean		Other vegetable		Stearin				
			Refined	Hydro- genated	Refined	Hydro- genated	Refined	Hydro- genated	Vege- table	Animal			
U. S.	101	1,000 lb. 210,449	1,000 lb. 15,620	1,000 lb. 20,635	1,000 lb. 47,570	1,000 lb. 33,912	1,000 lb. 2,792	1,000 lb. 4,042	1,000 lb. 9,903	1,000 lb. 50	1,000 lb. 61,981	1,000 lb. 13,865	1,000 lb. 3,918
N.Y., N.J.	11	40,458	2,801	2,739	11,979	11,479	3/	1,155	1,821	3/	3/	3/	767
Pa., Ohio, Md., Va., Ky.	11	26,488	4,146	3/	12,176	42	3/	---	1,188	---	6,983	582	871
N.C., S.C., Ga., Tenn., Fla., Ala.	18	35,647	1,860	11,512	1,519	7,049	3/	3/	1,637	---	12,384	1,883	160
Ind., Ill., Mich., Wis., Mo.	19	43,017	1,863	3,365	7,131	8,603	1,969	---	547	---	13,576	5,550	744
Ark., La., Okla., Tex. ...	19	32,608	2,638	1,177	9,026	4,723	3/	1,708	1,998	3/	8,932	1,619	760
Minn., Iowa, S. Dak., Kans., Neb. ...	8	10,995	3/	3/	---	3/	3/	3/	---	---	9,577	918	214
Calif.	11	21,172	2,294	1,540	5,739	1,836	3/	3/	2,712	---	3/	3/	402
Mont., Ore., Wash.	4	64	3/	3/	---	3/	---	---	---	---	3/	3/	---

MARGARINE

U. S.	101	156,413	2,574	26,018	6,685	81,112	281	1,193	2,352	3/	3,201	286	220		
N.Y., N.J.	11	19,579	3/	3,070	---	11,915	---	3/	3/	3/	3/	---	39		
Pa., Ohio, Md., Va., Ky.	11	3/	3/	3/	3/	3/	---	---	3/	---	---	---	17		
N.C., S.C., Ga., Tenn., Fla., Ala.	18	21,998	3/	3,701	---	12,728	---	---	---	---	3/	---	36		
Ind., Ill., Mich., Wis., Mo.	19	45,537	736	6,134	3/	23,921	186	3/	3/	---	834	3/	73		
Ark., La., Okla., Tex. ...	19	27,140	3/	5,743	3/	14,951	3/	---	---	---	3/	---	25		
Minn., Iowa, S. Dak., Kans., Neb. ...	8	3/	---	3/	---	3/	3/	---	---	---	---	---	---		
Calif.	11	21,780	1,101	5,662	3/	6,146	3/	3/	1,766	---	3/	3/	30		
Mont., Ore., Wash.	4	---	---	---	---	---	---	---	---	---	---	---	---		

^{1/} Operating season October 1, 1956, through September 30, 1957.

^{2/} Other refined oils include: Winterized, deodorized, oleo, peanut, palm, and coconut.

^{3/} Not shown to avoid disclosure of individual plant operations.

92 of the 101 plants operated for the full 12 months; the remaining 9 plants operated for an average of 8.6 months.

Source: Compiled from data collected by Bureau of the Census.

percent. This phenomenal increase in the production of margarine can be partly accounted for by:

(1) The use of large quantities of butter for military consumption during World War II required consumers to rely more heavily on the vegetable oils. This trend carried forward into the postwar years, and helps account for some of the substitution of margarine for butter.

(2) The removal of Federal and State taxes and State restrictions on production and use of margarine has had an effect. Currently only 2 States, Wisconsin and Minnesota, bar all sales of the colored product. California and Pennsylvania prohibit its use in public eating places.

(3) The costs of raw materials and manufacturing are such that the price of margarine has remained below prices of competing products.

(4) Increases in production have taken place to meet the demands of an increasing population.

Margarine is a compound consisting primarily of soybean and cottonseed oils, though small quantities of other vegetable and animal fats and oils also are used. The proportions of these different oils used in margarine production have undergone considerable changes since the prewar era. Prior to World War II, soybean and cottonseed oils accounted for approximately half of the total oils used in margarine, while the remaining 50 percent consisted of minor vegetable and animal fats and oils. By 1948, this relationship had changed, and soybean and cottonseed oils accounted for about 97 percent of the total oil ingredients. From 1948 to 1956, this relationship changed only slightly; in 1956, soybean and cottonseed oils accounted for 93 percent of the total oil used in margarine.

During 1948, cottonseed oil accounted for 62 percent of the oil used in margarine, while soybean oil accounted for 35 percent. Cottonseed remained the major oil used until the 1950 season, when soybean oil became the major oil. However, during this period the amount of margarine being manufactured increased so that the actual pounds of cottonseed oil used in the product decreased very little. From 1950 to 1956, the percentage of cottonseed oil used in margarine has decreased at a fairly constant rate. During the 1956 season, soybean oil accounted for 68 percent of the total oil used in margarine, and cottonseed oil for 25 percent (fig. 3). This substitution of soybean oil for cottonseed oil appeared to be continuing in 1958. In the biggest month of production during the 1956-57 season, soybean oil accounted for 71 percent and cottonseed oil for 23 percent of the total oil used in margarine. The remaining 6 percent included vegetable and animal stearin, lard, edible tallow, glycerides, deodorized oil, and other minor vegetable and animal fats and oils (table 17).

Margarine manufacturers have specific formulas which they follow in making margarine. The Federal Food, Drug and Cosmetic Act requires margarine to contain 80 percent fat and also restricts the quantities of the various other

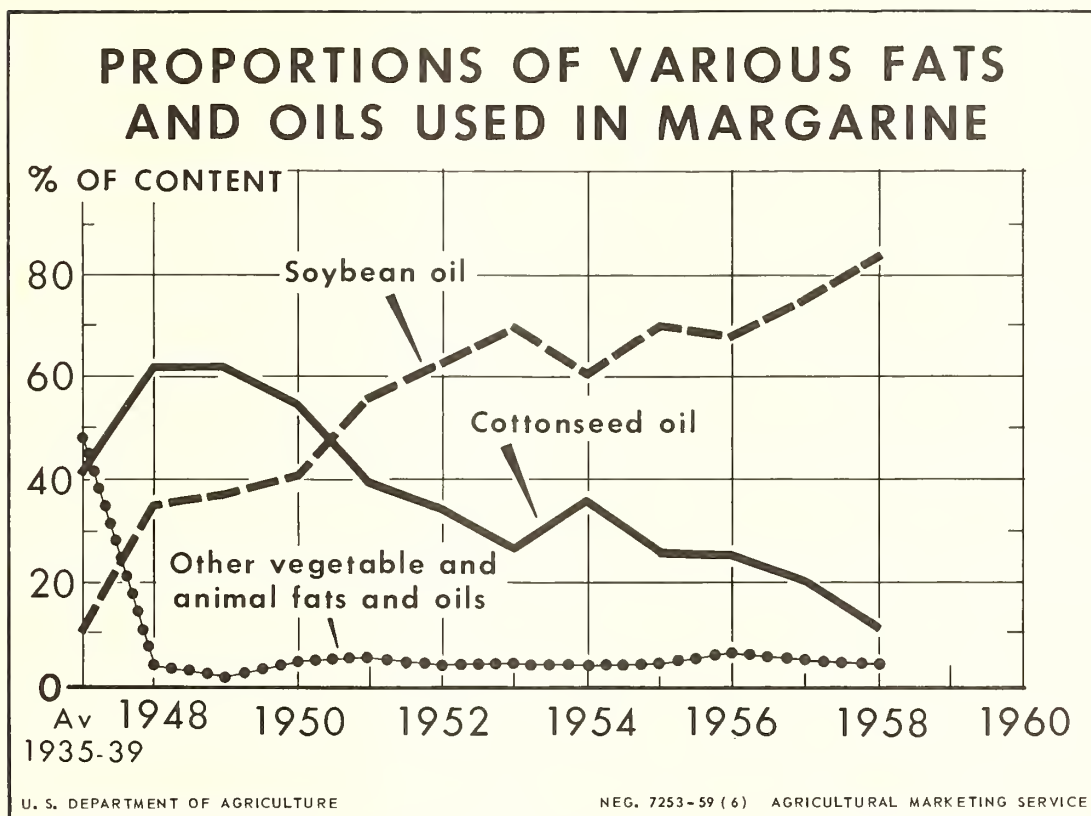


Figure 3

ingredients. Since fat is the greater portion of the finished product, the major price advantage that manufacturers might gain in buying raw materials comes in the purchase of fats and oils. The quantities of soybean and cottonseed oils used in margarine seem to be dependent on the relative prices of the two oils. But according to some margarine manufacturers, their formulas contain certain amounts of cottonseed oil regardless of the price advantage of competing oils. They feel that the addition of some cottonseed oil improves the quality of the finished product. This tendency to use some cottonseed oil regardless of price advantages of competing oils may represent partly a carry-over of practices followed when cottonseed oil was the principal oil ingredient in margarine. In the late 1950's, soybean oil has been used in larger quantities. This may be the result of (1) successful technological processes to retard the tendency of soybean oil to revert in flavor, and (2) the abundant supply and lower price of soybean oil.

In 1956-57, the margarine industry utilized about 77 percent of its estimated 1,877-million-pound annual production capacity. If the maximum production capacity were utilized, the margarine industry would require approximately 1,502 million pounds of vegetable and animal oils, since 80 percent of the weight of margarine is considered to be fats and oils.

Shortening

The production of shortening from vegetable and animal oils also has been increased, while use of lard as shortening has declined. From 1940 to 1957, the quantity of shortening produced has increased from 1,190 million pounds to 1,808 million pounds, or approximately 52 percent. From 1955 to 1957, production decreased by 8 percent.

Prior to 1940, cottonseed oil was the major oil used in shortening, accounting for 65 percent of the total oil used. Cottonseed oil was followed by "other" vegetable and animal fats and oils, 21 percent; soybean oil, 8 percent; edible tallow, 6 percent; and lard, less than $\frac{1}{2}$ of 1 percent. By 1948, this relationship had undergone considerable change. Soybean oil had increased in this use to 51 percent, and lard to 8 percent; and cottonseed oil had decreased to 23 percent, edible tallow to 2 percent, and other vegetable and animal fats and oils to 16 percent.

From 1948 to 1957, the use of soybean oil, cottonseed oil, and other vegetable and animal fats and oils decreased, while the use of lard and edible tallow increased.

During 1957, soybean oil decreased to 44 percent and cottonseed oil to 15 percent. Lard and edible tallow increased to 21 and 12 percent, respectively, while other vegetable and animal fats and oils accounted for 8 percent of the total oil used in shortening (fig. 4).

During 1956-57, the shortening industry utilized approximately 72 percent of its estimated 2,525-million-pound production capacity. If the maximum production capacity were utilized, it would require an additional volume of oil equal to the additional quantity of shortening produced, since shortening is considered to be 100 percent fats and oils.

Other Edible Products

Other edible products include fats and oils used as cooking and salad oils, in salad dressing and mayonnaise, and in bakery products and other food manufactures. Though these industries use much less oil than the margarine and shortening industries, they still account for a large quantity of the fats and oils used in the manufacture of foods. It is estimated that during 1956-57 the "other edible products" industry had an oil consumption capacity of approximately 1.5 billion pounds, about 27 percent greater than the actual quantity consumed that year. Winterized and deodorized oils accounted for over half of the total consumption (table 20).

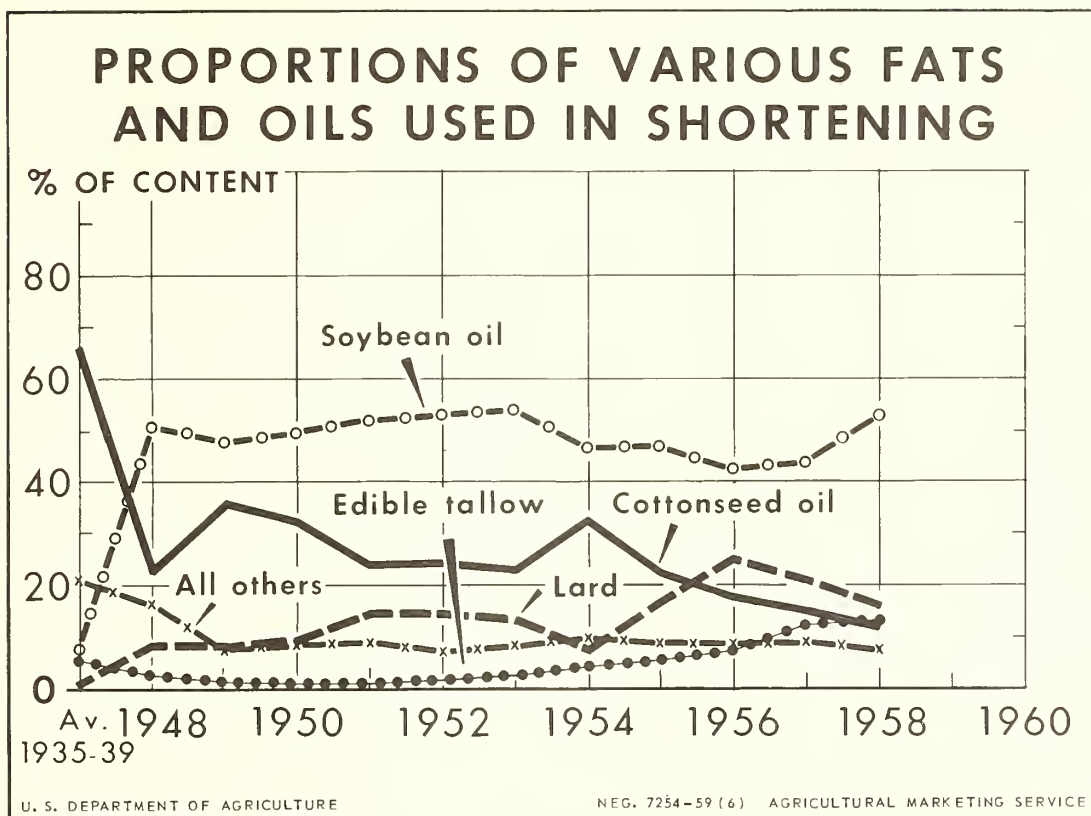


Figure 4

VEGETABLE AND ANIMAL FATS AND OILS USED IN THE PRODUCTION OF INEDIBLE PRODUCTS

The industry making inedible products containing fats and oils, which includes manufacturers of soap, paint, varnish, mixed feeds, and other industrial products, consumed approximately 3.4 billion pounds of vegetable and animal fats and oils during the 1956-57 season. It is estimated that this industry could consume nearly 4 billion pounds of vegetable and animal fats and oils in a year, or approximately 18 percent more than it used in 1956-57.

The type of fats and oils used in these industries depends on the type of product being manufactured. For instance, the paint and varnish industry is dependent on the drying and semidrying oils. The prices of individual drying oils historically have been subject to wide fluctuations. Shortages because of war, drought, or speculative interest have often resulted in rapid and substantial price changes. For example, raw linseed oil rose from a 1946 average price of 18.4 cents per pound to 34.0 cents per pound in 1947. During this same period, the average price of crude menhaden oil rose from 11.1 cents a pound to 18.6 cents a pound. Technological progress in the modification of oils has helped to widen the range of uses for the lower priced oils.

Table 20.- Number of plants using vegetable and animal oils in production of edible products (excluding margarine and shortening), and quantity used during most active month, 1956-57 season, by area ^{1/}

Area	Plants 2/	Vegetable oils									
		Cottonseed	Soybean	Coconut	Palm	Corn	Peanut	Other			
		Refined	Hydro- genated	Refined	Hydro- genated	Refined	Refined	Refined	Refined	hydro- genated	
United States 4/ ...	No. 103	1,000 lb. 3,401	1,000 lb. 1,994	1,000 lb. 7,463	1,000 lb. 1,180	1,000 lb. 2,677	1,000 lb. 4,394	1,000 lb. 3,399	1,000 lb. 396	1,000 lb. 1,343	
Mass., R.I., N.Y., N.J.	22	700	419	966	369	246	5/	5/	259	508	
Pa., Ohio, Md., Ky., Del.	13	191	599	3,052	5/	212	5/	5/	5/	---	
N.C., Ga., Tenn.	11	5/	5/	5/	256	68	---	---	---	---	
Ind., Ill., Mich., Wis., Minn., Iowa, Mo.	30	1,181	670	2,632	279	2,038	5/	1,472	16	673	
La., Tex.	11	5/	127	5/	5/	---	---	---	---	5/	
Idaho, Wash., Calif.	16	938	5/	205	---	113	---	5/	5/	5/	
		Vegetable oils (cont.)			Animal oils		Other oils				
		Stearin	Other	Deodor- ized	Winter- ized	Lard	Tallow	Stearin	Mono- di- glycer-	Glycerin	Total
		3/							ides		
United States 4/ ...		1,000 lb. 364	1,000 lb. 11,196	1,000 lb. 21,636	1,000 lb. 49,089	1,000 lb. 7,221	1,000 lb. 1,758	1,000 lb. 604	1,000 lb. 734	1,000 lb. 1,595	1,000 lb. 120,444
Mass., R.I., N.Y., N.J.	70	5/	5/	7,903	1,500	493	---	5/	619	22,762	
Pa., Ohio, Md., Ky., Del.	5/	---	5/	5/	5/	93	---	---	155	7,128	
N.C., Ga., Tenn.	5/	---	5,427	5/	5/	5/	---	5/	5/	15,164	
Ind., Ill., Mich., Wis., Minn., Iowa, Mo.	5/	5/	5,841	10,783	1,644	474	525	290	414	42,271	
La., Tex.	---	---	5/	9,249	2,888	5/	---	---	126	16,505	
Idaho, Wash., Calif.	5/	---	5/	11,134	193	5/	56	5/	5/	15,630	

^{1/} October 1, 1956, through September 30, 1957. The total of an individual oil may not necessarily be the greatest quantity of that oil consumed during any specific month. Due to the substitutability of these oils, the totals have been based on the combined consumption of all oils utilized by each plant during their respective months of biggest production. This table excludes margarine and shortening.

^{2/} Includes only those plants reporting on a monthly basis.

^{3/} Includes refined maize (sorghum), wheat germ, castor, sesame, crude coconut, and corn.

^{4/} The quantity of oil used in those plants reporting on an annual basis has been estimated and included in the United States total. Due to the small amount of oil consumed and the lack of adequate data, those plants reporting on an annual basis have not been included in the breakdown by States and regions.

^{5/} Omitted to avoid disclosure of individual plant operations.

Source: Compiled from data collected by Bureau of the Census.

Therefore, lower priced oils can now be substituted for higher priced oils in the manufacture of many products. Results have been (1) a smoothing out of prices among various competing oils, and (2) a price level for raw materials somewhat below the price level of the late 1940's.

For approximately a 20-year period, linseed oil dominated the drying oil market with a relative share of 75 percent. Its use has diminished greatly, however, in the 1950's. The quantity used during the largest month of production for the 1956-57 season indicates that linseed oil now accounts for about 56 percent of the total oil used in paint and varnish. During the 1956-57 season, the paint and varnish industry used about 482 million pounds of vegetable and animal fats and oils. Based on the capacity data for 1956-57, it is estimated that each year the paint and varnish industry could consume approximately 687 million pounds of fats and oils (table 21), or approximately 43 percent more than it used in 1956-57.

The soap industry, which consumes large quantities of both animal and vegetable fats and oils, is the largest single user of inedible fats and oils. The major oils used in the soap industry are inedible tallow and grease, which account for over 65 percent of the oil used, followed in order by coconut oil, vegetable foots, and tall oil. In 1956-57, the soap industry had an estimated consumption capacity of 1.4 billion pounds of fats and oils. During the 1956-57 season, the industry used 1.0 billion pounds of fats and oils (table 22), or approximately 70 percent of its estimated capacity.

The mixed feed industry in recent years has become an important user of inedible tallow and grease. With the increased use of solvent extraction in oilseed processing plants, the quantity of oil left in the meal has been lower, thereby lowering the quality of the meal in certain respects. This has created a new outlet for inedible tallow and grease, the prices of which were enough below those of vegetable oils to make it economically feasible to extract as much oil as possible from the oilseed and then add less expensive inedible tallow and grease or vegetable oil foots to the feed mix.

In the industry producing inedible products which contain vegetable and animal fats and oils, inedible tallow and grease are by far the most important. On the basis of the quantity consumed during the month of largest production for 1956-57, inedible tallow and grease accounted for approximately 43 percent of the oil ingredients used. Next in importance was linseed oil, which accounted for 15 percent, followed in order by coconut, 11 percent; soybean, 7 percent; and tall oil, 6 percent. The remaining 18 percent includes cottonseed oil and other vegetable and animal fats and oils (tables 21, 22, 23, and 24). These figures have been based on the quantities used during the month of largest production, and therefore may not be representative of the 1956-57 operating year, since these oils may be substituted for one another during different months.

Table 21.--Number of plants using vegetable and animal oils in production of paint and varnish, and quantities used during most active month, 1956-57 season, by State and area 1/

State and area	Plants 2/	Oils used														Glycerin refined : 5/		
		Linseed		Tall		Soybean		Coconut		Foots		Castor		Other : hydro- genated :				
		Raw	Refined	Crude	Refined	Tung refined	lb.	lb.	lb.	lb.	lb.	lb.	lb.		lb.			
U. S. 6/	No. 233	1,000 lb. 15,620	1,000 lb. 16,976	1,000 lb. 349	1,000 lb. 2,746	1,000 lb. 3,451	1,000 lb. 9,084	1,000 lb. 701	1,000 lb. 1/	1,000 lb. 576	1,000 lb. 192	1,000 lb. 760	1,000 lb. 499	1,000 lb. 661	1,000 lb. 144	1,000 lb. 1,130	1,000 lb. 3,595	1,000 lb. 57,270
N. Y.	23	1,235	867	1/	400	399	701	1/	1/	1/	1/	39	158	1/	1/	252	1/	6/
N. J.	20	1,371	2,212	---	354	343	679	1/	---	---	---	95	58	1/	---	165	337	6/
Mass., R. I.	8	363	256	---	51	34	1/	---	---	---	---	1/	1/	---	---	1/	1/	6/
Pa.	20	1,362	1,103	---	48	280	470	---	---	---	---	22	1/	1/	---	62	413	6/
Ohio	24	1,341	1,134	---	210	276	944	101	1/	101	1/	24	54	1/	---	59	217	6/
Del., Md., D. C., Va., Ky.	18	1,087	1,656	1/	371	384	1,828	1/	---	---	---	204	1/	---	---	42	893	6/
N. C., Ga., Fla., Tenn., Ala.	8	292	526	---	207	33	112	---	---	---	---	1/	1/	---	---	21	1/	6/
Ill.	26	2,578	2,473	1/	505	563	1,492	1/	1/	1/	1/	52	48	---	---	233	275	6/
Mo.	13	512	797	1/	30	150	345	1/	---	---	---	9	36	1/	---	11	88	6/
Mich.	10	291	608	---	1/	1/	752	154	---	---	---	63	1/	---	---	22	565	6/
Wis., Ind.	8	586	691	---	1/	123	216	---	---	---	---	84	---	---	---	67	235	6/
Ark., La., Okla., Tex.	13	1,197	803	---	44	150	300	---	---	---	1/	1/	1/	---	---	13	102	6/
Minn., Iowa, Colo.	10	263	709	1/	1/	58	148	---	---	---	---	1/	1/	---	---	24	1/	6/
Wash., Ore.	4	120	62	---	1/	1/	1/	---	---	---	---	---	---	1/	---	1/	1/	6/
Calif.	28	851	1,263	1/	283	304	509	1/	1/	1/	1/	45	15	423	1/	296	324	6/

1/ October 1, 1956, through September 30, 1957. The total of an individual oil may not necessarily be the greatest quantity of that oil consumed during any specific month. Due to the substitutability of these oils, the totals have been based on the combined consumption of all oils utilized by each plant during their respective months of biggest production.

2/ Includes only those plants reporting on a monthly basis.

3/ Includes some crude and hydrogenated soybean oil.

4/ Includes some refined castor oil.

5/ Included in the U. S. total are: Refined corn, crude cotton, and hydrogenated animal oil. These oils account for less than 2 percent of the total oil consumed and therefore have not been included in the breakdown by State and area.

6/ The quantities of oil used in those plants reporting on an annual basis have been estimated and included in the United States total. Due to the small amount of oil consumed and the lack of adequate data, those plants reporting on an annual basis have not been included in the breakdown by State and region.

1/ Omitted to avoid disclosure of individual plant operations.

Source: Compiled from data collected by Bureau of the Census.

Table 23.--Number of plants using vegetable and animal oils in production of inedible products (excluding soap, paint, and varnish) and quantities used during most active month, 1956-57 season, by area ^{1/}

Area	Plants 2/	Vegetable										
		Linseed		Tall		Soybean		Coconut		Palm	Castor	Tung
		Raw	Refined	Crude	Refined	Crude	Refined	Crude	Refined	Crude	Crude	
		No.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.	1,000 lb.
United States ^{3/}	495	10,276	7,370	6,508	7,248	2,854	9,134	4,584	6,817	8,985	5,687	870
Me., N. H., Vt., Mass., R. I., N. Y., Conn., N. J.	134	2,379	2,673	886	1,583	1,120	3,193	899	57	4,907	514	468
Pa., Ohio, Md., Va., W. Va., Ky., Del.	126	3,777	1,067	4,127	1,006	464	2,231	4/	178	3,560	4,809	143
Tenn., N. C., S. C., Miss., Ala., Ga., Fla.	44	4/	4/	4/	2,910	4/	4/	4/	4/	253	4/	4/
Ind., Ill., Wis., Mich., Mo.	98	366	673	4/	1,592	1,084	1,908	851	51	4/	218	111
Minn., Iowa, Neb., Colo., Kans.	23	4/	4/	---	---	4/	4/	4/	---	---	---	4/
Okla., Ark., La., Tex.	23	4/	4/	4/	4/	4/	160	---	---	---	4/	4/
Utah, Ariz., Calif., Wash., Ore., Idaho	47	577	189	213	4/	4/	578	4/	4/	4/	47	15
Vegetable (cont.) : Animal												
Cotton- : Hydro- : Tallow and : Hydro- : Fish : Marine : Other : Glycerin : seed : Foots : genated : grease (inedible) : genated : oil : mammal : 5/ : refined : Total refined : : : Crude : Refined : : : : : : : : : lb. lb. lb. lb. lb. lb. lb. lb. lb. lb. lb. lb.												
United States ^{3/}	311	3,081	1,762	45,729	2,351	2,326	3,575	7,286	3,327	13,851	148,245	
Me., N. H., Vt., Mass., R. I., N. Y., Conn., N. J.	80	686	467	5,360	183	17	1,694	3,198	1,376	2,560	33,786	
Pa., Ohio, Md., Va., W. Va., Ky., Del.	194	1,144	4/	14,158	1,287	4/	413	2,661	811	6,104	45,022	
Tenn., N. C., S. C., Miss., Ala., Ga., Fla.	4/	4/	4/	5,493	452	123	4/	4/	186	2,339	15,042	
Ind., Ill., Wis., Mich., Mo.	16	4/	737	7,069	277	1,898	283	1,187	476	1,881	21,131	
Minn., Iowa, Neb., Colo., Kans.	---	---	---	6,278	---	---	4/	4/	4/	4/	13,777	
Okla., Ark., La., Tex.	4/	276	401	4,216	---	4/	126	4/	4/	4/	5,564	
Utah, Ariz., Calif., Wash., Ore., Idaho	4/	168	32	3,155	152	204	682	61	345	502	13,923	

^{1/} October 1, 1956, through September 30, 1957. The total of an individual oil may not necessarily be the greatest quantity of that oil consumed during any specific month. Due to the substitutability of these oils, the totals have been based on the combined consumption of all oils utilized by each plant, during their respective months of biggest production. ^{2/} Includes only those plants reporting on a monthly basis. ^{3/} Due to lack of adequate data these totals do not include those plants reporting on an annual basis. The above totals should be within approximately 5 percent of the actual totals. ^{4/} Omitted to avoid disclosure of individual plant operations. ^{5/} Includes crude: Cotton, corn, glycerin; Refined: Castor, peanut, corn, palm, and safflower; wheat germ, sesame, oiticica, edible tallow, lard, rice bran, olive, rapeseed, mustard seed, cashew, winterized oil, deodorized oil, oleo edible animal stearin, monoglycerides and diglycerides, synthetic triglycerides, and other hydrogenated oils.

Source: Compiled from data collected by Bureau of the Census.

Table 24.--Number of plants refining vegetable and animal oils and number of plants using these oils in edible and inedible products, by State, 1956-57 season 1/

State	: Edible products:				: Inedible products:				: Edible products:				: Inedible products:			
	: Refining:	: and :	: Paint:	: Other:	: Refining:	: and :	: Paint:	: Other:	: Refining:	: and :	: Paint:	: Other:	: Refining:	: and :	: Paint:	: Other:
	: shortening:	: 2/:	: Soap:	: varnish:	: shortening:	: 2/:	: Soap:	: varnish:	: shortening:	: 2/:	: Soap:	: varnish:	: shortening:	: 2/:	: Soap:	: varnish:
U.S. ...	No. 126	No. 101	No. 103	No. 233	No. 95	No. 495	No. 233	No. 495	No. 101	No. 103	No. 233	No. 495	No. 101	No. 103	No. 233	No. 495
Me.	---	---	---	---	---	2	---	2	1	---	---	---	---	---	---	4
N.H.	---	---	---	---	---	1	---	1	2	---	---	---	---	---	5	12
Vt.	---	---	---	---	---	2	---	2	12	---	---	---	---	---	26	48
Mass.	3	---	1	7	5	22	1	22	1	---	---	---	---	---	10	20
R.I.	---	---	1	1	2	4	---	4	1	---	---	---	---	---	3	6
Conn.	---	---	---	---	2	6	---	6	2	---	---	---	---	---	5	7
N.Y.	5	3	9	23	12	39	---	39	1	---	---	---	---	---	1	7
N.J.	6	8	11	20	8	58	---	58	3	---	---	---	---	---	13	12
Del.	---	---	1	1	---	13	---	13	---	---	---	---	---	---	1	1
Pa.	3	1	5	20	5	43	---	43	1	---	---	---	---	---	1	5
Ohio	8	6	4	24	11	39	---	39	14	---	---	---	---	---	9	13
Md.	2	2	1	6	2	7	---	7	2	---	---	---	---	---	2	4
Va.	2	1	---	1	1	13	---	13	2	---	---	---	---	---	---	6
D.C.	---	---	---	---	---	---	---	---	1	---	---	---	---	---	---	1
W. Va. ...	---	---	---	---	---	7	---	7	---	---	---	---	---	---	4	2
N.C.	3	1	2	2	---	12	---	12	---	---	---	---	---	---	---	1
S.C.	3	1	---	---	1	1	---	1	---	---	---	---	---	---	---	2
Ga.	6	9	5	3	2	9	---	9	---	---	---	---	---	---	---	1
Ky.	1	1	2	8	---	4	---	4	2	---	---	---	---	---	1	1
Tenn.	6	5	4	1	---	10	---	10	1	---	---	---	---	---	3	1
Miss.	1	---	---	---	---	---	---	---	1	---	---	---	---	---	---	---
Ala.	3	1	---	1	---	4	---	4	1	---	---	---	---	---	28	41
									21							

1/ October 1, 1956, through September 30, 1957. Includes only those plants reporting to the Bureau of the Census on a monthly basis.

2/ Includes salad dressing, salad oil, etc.

3/ Includes feed, linoleum, oilcloth, etc.

Source: Compiled from data collected by Bureau of the Census.

